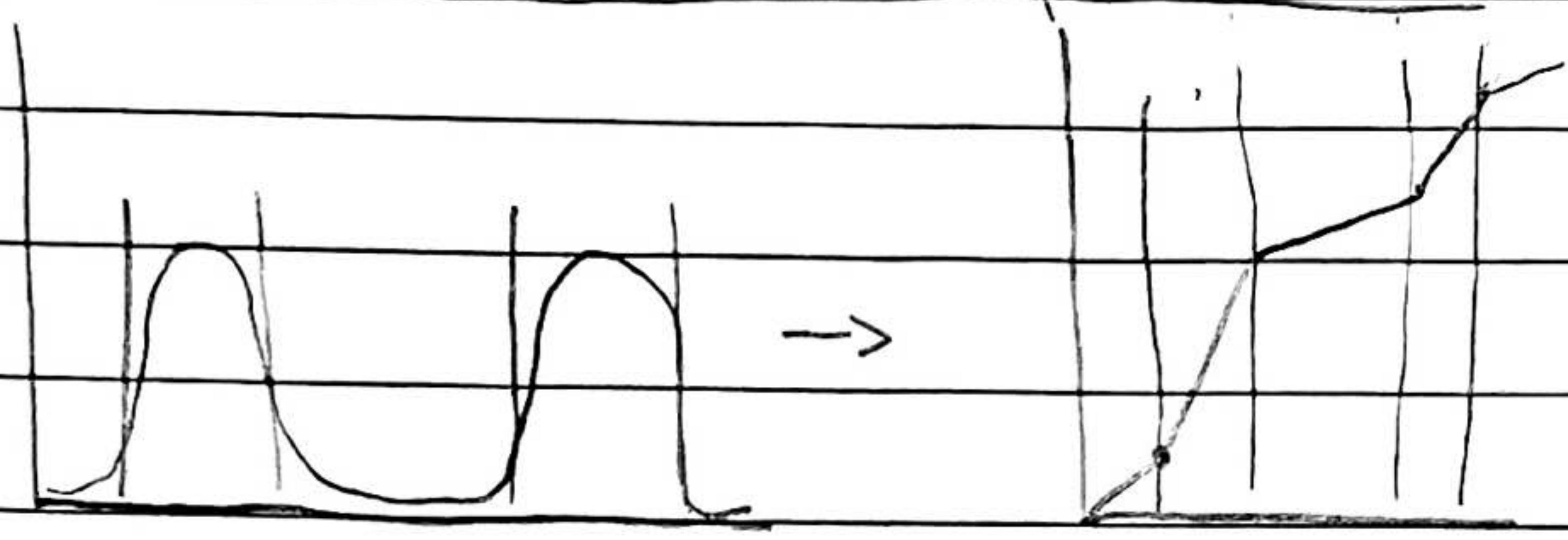
HW - 3

3.1) 1) What can we say about $x[n_1, n_2]$?

Considering there are two streched segments w/ equal frequencies (height), we can say that there are two peaks w/ concentrated distributions (Gray Image)

2) Sketch transformation to improve contrast



3.2) Show that second pass of histogram equalization will produce exactly the same result as first pass

- When histogram equalization is applied twice, nothing changes from the first pass

$$S_k = T(r_k) \sum_{j=0}^{k} \frac{n_{r_j}}{n} = \frac{1}{n} \sum_{j=0}^{k} n_{r_j}$$

n_{r_j} = # of pixels
r_j = intensity value of pixels

- Since every value r_k is mapped to value S_k, it shows that $n_{S_k} = n_{r_k}$
- Second pass would be

$$V_k = T(S_k) = \frac{1}{n} \sum_{j=0}^{k} n_{r_j} = S_k$$

- Because values are mapped by index, it will map to the same result as the first pass

HW-3

3.3) 1) Determine root signal of x[n] using 3-point median filter

$$\begin{array}{c} \quad\; 0\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10\ 11\ 12\ 13\ 14\ 15\ 16\ 17\ 18\ 19\ 20\ 21\ 22\ 23 \\ x[n] = [0\ 0\ 0\ 2\ 3\ 3\ 2\ 2\ 5\ 3\ 3\ 3\ 4\ 3\ 5\ 3\ 2\ 2\ 1\ 5\ 2\ 0\ 0\ 0] \end{array}$$

$$\begin{array}{c} \text{root signal} = [0\ 0\ 2\ 3\ 3\ 2\ 2,\ 3,\ 3\ 3\ 3\ 3\ 4\ 3\ 3\ 2\ 2\ 2\ 2\ 2\ 0\ 0\ 0] \\ \qquad\qquad\quad 0\ 1\ 2\ 3\ 4\ 5\ 6\ 7\ 8\ 9\ 10\ 11\ 12\ 13\ 14\ 15\ 16\ 17\ 18\ 19\ 20\ 21\ 22 \end{array}$$

2) Is it possible to recover x[n] from root signal w/o additional information about x[n]?

- We cannot recover x[n]

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3) Determine the output y[n] when a recursive 3-point median filter is applied to x[n] above

$$y[n] = \text{Median}(y[n-1], x[n], x[n+1])$$

y[n] = [[0 0], [0 0 0], [0, 0, 2], [2, 2, 3] [3, 3, 3] [3, 3, 2], [2, 2, 2], [2, 2, 5]
[3 5 3] [3 3 3] [3 3 3] [3 3 4] [3 4 3] [4 3 5] [3 5 3] [3 3 2]
[2 2 2] [2 2 1] [2 1 5] [2 5 2] [2 2 0] [0 0 0] [0 0 0]]

y[n] = [0 0 0 2 3 3 2 2 3 3 3 3 3 4 3 3 2 2 2 2 2 0 0]

4) Yes, this is consistent with the results

HW-3

3.4) 1) Why is the filter effective in removing pepper noise when Q is positive?

Because pepper noise is due to pixel values of 0, having a positive Q will cause these pixels to approach the brighter pixels in its neighboorhood.

2) Why is the filter effective in diminishing salt noise when negative?

Like pepper noise, but opposite, salt noise is when a pixel value is close to 255. Thus, having a negative Q will cause the pixel to become darker like its neighbors

3) Discuss behavior of the filter in areas of gray level

Regardless of Q, these filters do not effect the pixels if the image is gray scale.